

CHAPTER 6

Oak Savanna Communities

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DESCRIPTION

The term savanna is used in the Midwest to describe an ecosystem bordered by the prairies of the west and the deciduous forest of the east—a mosaic maintained by frequent fires and possibly by large ungulates.

The term *savanna* has never been well defined. It has its origin in the early Spanish colonization of the Caribbean in the 16th century, where it was applied to treeless grassy plains (Johnson and Tothill 1985). By the end of the 19th century, this Spanish term was widely used by plant geographers to describe tropical grasslands. Also by this time, woody plants had become an accepted and, in some cases, even mandatory part of the definition. By the mid-20th century ecologists were still struggling with the definition of savanna, especially in North America (Penfound 1962). Cole (1960) summed up the situation this way: “Perhaps of all types of vegetation the savanna is the most difficult to define, the least understood, and the one whose distribution and origin is the

most subject to controversy.” Today there is still no widely accepted, clear-cut definition of what is meant by savanna.

Fortunately for us in the Midwest, the term *savanna* has a relatively narrow definition. Here it is generally used to describe an ecosystem that was historically part of a larger complex bordered by the prairies of the west and the deciduous forests of the east. This complex was a mosaic of plant community types that represented a continuum from prairie to forest. Savannas were the communities in the middle of this continuum. The mosaic was maintained by frequent fires and possibly by large ungulates such as bison and elk. Oaks were the dominant trees, hence the term *oak savanna*.

Because savannas grade into both prairie and forest, there are no clear dividing lines between savanna and these two communities. In classifying the plant communities of Wisconsin, Curtis (1959) was forced to set limits for what he called savanna. He ultimately defined it as having no less than one tree per acre and no more than a 50% tree canopy. However, Curtis made it clear that these limits were arbitrary and chosen purely for convenience. Curtis also subdivided Wisconsin savannas into four categories based on plant composition: *oak barrens*, *pine barrens*, *oak opening*, and *cedar glade*. He defined *oak barrens* as savannas with black/Hill’s oak on infertile, droughty sand or sandstone-derived soils. *Pine barrens* were defined as savannas with jack/red pine on similar soil types as oak barrens. *Oak openings* were defined as savannas on rich, mesic soils with mostly bur or white oak. *Cedar glades* were defined as savannas on dry limestone bluffs, with red cedar more prevalent than oaks. Another savanna community type, wet and wet-mesic soil savannas, was not listed by Curtis, because not enough intact examples could be found at the time of his study. Bur and swamp white oak were probably the dominant trees of this community historically. The following discussion mostly covers the community types Curtis called oak opening, but it applies to other savanna types as well. The sandy soil oak and pine

barrens are covered in a separate chapter in this report.

Just what the understory and ground layer vegetation of oak savannas was like is largely unknown. Bray (1960) described the oak savannas as having less grass and more forbs and woody shrubs than prairie, but more grass and fewer forbs than forest. Historically, the savanna community was probably a slowly shifting mosaic of plant species associations that had varying degrees of shade and sun tolerance. Consequently, the flora of oak savanna was probably a blend of the following species:

- ▲ True “sun-loving” prairie species that can tolerate or survive only light shading.
- ▲ Prairie-associated species that do well, or perhaps slightly better, in light shade than in full sun.
- ▲ True savanna species that do best in, or are restricted to, a blend of shade and sun.
- ▲ Forest-associated species that do well with fire and moderate amounts of sunlight.
- ▲ True forest species that can persist, but do not necessarily thrive, with occasional fire and moderate sunlight.

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Although oak savannas were probably relatively dynamic communities compared with prairies or forests, major vegetation changes within these savannas still took decades if not centuries to occur.

Detailed descriptions of Wisconsin oak savanna vegetation can be found in works by Bray (1958, 1960) and Curtis (1959). These studies provide the best available data on savanna vegetation; however, they should not be considered the final word on historical savanna. By the time these studies were done, the savanna as a complete ecosystem had already been gone for 100 years. The remnants available



for Bray, Curtis, and others to study were limited in number and size and had probably already been altered to some degree by absence of fire and a history of domestic livestock grazing. Recent information and observations resulting from savanna

restoration attempts over the past decade suggest that the original oak savanna vegetation may have been even more diverse and specialized than the Bray and Curtis

studies indicate (Packard 1988a, 1988b; Bronny 1989; Clewell 1989; Pruka 1994; W. Pauly, Dane Co. Parks, unpubl. data; R. Henderson, Wis. Dep. Nat. Resour., unpubl. data).

The more wooded part of the historical prairie-forest complex (i.e., savanna or woodlands with 50%-100% tree canopy) is known to us only through the early accounts of explorers and settlers. This community was already so distorted by lack of fire and other disturbances by the mid-1900s that it was not even classified and studied as a separate community by Curtis and his students. What remained of this community at the time of the Curtis studies (i.e., grown-in savannas) was lumped with the dry or dry-mesic southern hardwood forest communities based on the residual oak trees, often independent of the actual soil moisture regimes of the sites. Recent

An oak opening is a savanna on rich, mesic soils with mostly bur or white oaks. Here is a white oak with prairie-like understory in a subdivision in Dane County. This tree has typical open-grown architecture, is more than four feet in diameter, and probably got its start around the Revolutionary War. *Photo by Richard Henderson.*



research is now starting to shed some light on this plant community. Pruksa (1994) studied the sorting out of groundlayer plant species along the natural sunlight gradients found in savanna and woodland.

This more heavily wooded portion of the prairie-forest complex (up to and including 100% closed canopy) might best have been described as an open oak woodland. Although much work needs to be done in describing and understanding this community, it should most likely be viewed as separate from oak forest. Based on historical accounts, it had a “park-like” structure, with the dense shrub and understory tree layers associated with oak forests of today kept sparse and low in stature by fire. The ground layer was probably dominated by forest species of low- to mid-shade tolerance (e.g., summer- and fall-blooming grasses, sedges, legumes, and composites) that are today doing best in forest gaps and edges, and savanna species of mid- to high-shade tolerance.

STATUS

PAST

Oak savanna has probably been in North America for 20-25 million years (Barry and Spicer 1987), shifting about and expanding and contracting with climatic changes. For the past several thousand years it has existed in a more or less stable and continuous band covering millions of acres in what is now Minnesota, Wisconsin, Iowa, Illinois, Michigan, Indiana, Ohio, Missouri, Arkansas, Oklahoma, and Texas. Historically, what is now Wisconsin was probably a leader in total acres of oak

savanna. At the time of Euro-American settlement, Wisconsin had an estimated 5.5 million acres of oak savanna (not including the 4.1 million acres of oak and pine barrens) (Curtis 1959) and an additional 1.4 million acres of oak forest, much of which may have been open oak woodland (see Fig. 10).

PRESENT

In the early to mid-19th century, the oak savanna as an ecosystem was thoroughly fragmented and nearly totally destroyed throughout its range. Most of its

acreage suffered one of the following fates: (1) clearing and plowing, (2) overgrazing, or (3) invasion by dense shrub and tree growth due to lack of fire, lack of grazing, or both. Oak savanna now shares equal billing with tallgrass prairie as the most threatened plant community in the Midwest and among the most threatened in the world. Intact

examples of oak savanna vegetation are now so rare that less than 500 acres are listed in the Natural Heritage Inventory as having a plant assemblage similar to the original oak savanna. This is less than 0.01% of the original 5.5 million acres.

Many plant species that were probably savanna specialists are now uncommon and are found only in the fringes and openings of oak woods, brushy areas, and lightly grazed pastures. Some examples are yellow pimpernel, pale Indian plantain, woodland thistle, downy wild rye, elm-leaved goldenrod, New Jersey tea, sessile-leaved eupatorium, and horse gentian. Two likely savanna specialists (purple milkweed and wild hyacinth) are listed as endangered in the state and three others (kitten tails, cream gentian, and Virginia lespedeza) are listed as threatened.

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Fortunately, most of the savanna species, especially the mammals, birds, reptiles, and amphibians, have readily adapted to the changed landscape, or they have managed to hang on and survive to this point in suboptimal habitat (e.g., the fringes of other less devastated communities such as oak forests). The success of the vertebrate animals has been due to the fact that major elements of the savanna structure are still well represented today in various “edge” habitats, including wooded pastures, lawns, and woodlots. The fact that the plant species may be different in those habitats has not affected savanna vertebrate species for the most part.

Many of the mammal species that were closely associated with our historical oak savannas are still doing well today (e.g., long-tailed weasel, cottontail rabbit, woodchuck, fox squirrel, red fox, and white-tailed deer). However, others have been either extirpated from the former savanna regions (e.g., timber wolf, bison, and elk) or reduced to very low numbers (e.g., bobcat and black bear). The loss of these species, however, was due more to incompatibility with high human densities than to loss or degradation of the oak savanna plant communities. Some mammals associated with the most open savannas (and the prairies) have not fared as well with the changes. For example, the least shrew and the Franklin’s ground squirrel are of special concern in the state.

Most savanna bird species are still doing very well today (e.g., American robin, indigo bunting, blue jay, American goldfinch, and brown thrasher). Only one oak savanna bird, the passenger pigeon, has become extinct, and another, the turkey, was extirpated but restored; both of these were lost to unregulated hunting rather than loss of habitat. However, a number of savanna bird species have not thrived or have begun to decline in recent years (e.g., black-billed cuckoo, northern flicker, red-headed woodpecker, warbling vireo, vesper sparrow, bobwhite quail, and field sparrow). One species, the orchard oriole, is on the state’s list of special concern; one, Bell’s vireo, is on the state’s list of threatened



species; and two others, the loggerhead shrike and barn owl, are on the state’s endangered species list (D. Sample and M. Mossman, Wis. Dep. Nat. Resour., pers. comm.). Although loss of habitat has not been the cause of decline in all these species, it certainly is affecting many of them. The abandonment and loss of savanna/woodlot pastures in the past few decades may be playing a role in some of these recent declines in savanna bird species.

Most of the amphibian and reptile species that were closely associated with our historical oak savannas are still doing at least moderately well today (e.g., Cope’s gray treefrog, five-lined skink, eastern hognose snake, smooth green snake, western fox snake, eastern milk snake, and Dekay’s snake). However, two reptiles associated with savanna habitat are suffering from habitat loss. These are the western slender glass lizard and the eastern massasauga rattlesnake; both are now on the state list of endangered species. Oak savanna sites may be important nesting sites for turtle species such as the threatened Blanding’s turtle in some areas, as agriculture continues to dominate open spaces traditionally used for turtle nesting.

Unlike the vertebrate communities, our knowledge of oak savanna invertebrates is very limited. We don’t know what species were characteristic or restricted to the community, let alone their current status. It is likely that many species were lost or are now very rare.

This property in Waukesha County shows what is thought to be the typical tree structure of oak openings. Since Euro-American settlement, oak openings have almost disappeared from the landscape because of clearing, plowing, overgrazing, or suppression of fire followed by invasion by dense shrub and tree growth. As Curtis (1959) observed, “Beyond question, an oak savanna with an intact groundlayer is the rarest plant community in Wisconsin today.”
Photo by Eric Epstein.



PROJECTED

In the absence of active management, the future of oak savanna looks very bleak in Wisconsin and throughout its entire range. The increasing abandonment of lightly to moderately grazed wooded pastures and the accelerating succession of oak woodlots toward heavy-shade-producing trees and shrubs will lead to the decline and possible loss of much of what remains of the savanna flora and fauna, including eventual decline of the oaks themselves.

ACTIONS CAUSING CONCERN

Threats to the future survival of oak savanna can be summarized in five categories.

- ▲ Loss of recovery opportunities due to
 - ✓ accelerating forest succession to dense-shade-producing species,
 - ✓ lack of recruitment and eventual die-out of long-lived plants in suboptimal habitat,
 - ✓ increasing or decreasing grazing pressure, due to changes in pasturing practices.
- ▲ General neglect and lack of knowledge about the community by the public, professional resource managers, and scientists.
- ▲ Resistance to the use of prescribed fire, especially in wooded areas, and lack of understanding by the public and professionals as to the importance of fire in maintaining the state's biodiversity.

Threats to the future survival of oak savanna include the lack of knowledge about the community, the resistance to the use of prescribed fire, the lack of understanding of the importance of fire in maintaining oak savanna, and increasing human population pressures, often expressed as rural home and suburban development.

- ▲ Invasion by aggressive exotics (i.e., honeysuckle, buckthorn, and reed canary grass).
- ▲ Increasing human population pressures, often expressed as rural home and suburban development.

SOCIO-ECONOMIC ISSUES

Oak savanna was probably the optimum habitat for many game species (e.g., bobwhite quail, turkey, squirrels, deer, and rabbits). Thus, management for oak savanna is compatible with traditional wildlife management and hunter interests. The popularity of savanna songbirds, such as bluebirds, should also lend public support to oak savanna restoration. Light to moderate cattle grazing can be compatible with maintaining the plant structure needed by many savanna species. There is support among private conservation groups for oak savanna protection and recovery; it is a high priority for The Nature Conservancy. However, the public in general lacks knowledge about savannas.

POTENTIAL FOR COMMUNITY RESTORATION

The recovery potential of oak savanna in Wisconsin is substantial (Holtz 1985; Bronny 1989; R. Henderson, Wis. Dep. Nat. Resour., unpubl. data). Degraded sites in the dry and wet ends of the spectrum can be recovered with relative ease. Mesic savannas with deep, rich soils will take more time and work, but recovery is still feasible. The pieces can still be found and put back together with a reasonable amount of effort (Packard 1988b). How-

ever, biological and socio-economic opportunities are gradually and steadily disappearing.

Currently there are hundreds if not thousands of acres of overgrown but retrievable oak savanna on Department-managed lands. In addition there are probably thousands of acres of private land, both overgrazed and overgrown, with retrievable oak savanna. Much of this land, especially low productivity sites, could be restored within a decade or two simply by tree thinning, brushing, and burning. Well-drained, rich soil sites will require more work and time to restore. Some plant reintroduction may be necessary, but much can be accomplished with fire alone. Light grazing may also have potential as a savanna management tool and as a means of maintaining the open habitat required by many savanna vertebrates. Grazing, however, should not be considered the best management tool for most savanna plants, although some may do well under light grazing.

POSSIBLE ACTIONS

The following possible actions are consistent with ecosystem management, but require more analysis and discussion. How priorities are set within this list will be based on ecoregion goals, staff workload, fiscal resources, public input and support, and legal authority. We will work with our customers and clients to set priorities and bring recommendations to the Natural Resources Board for consideration beginning in the 1995-97 biennium.

1. Develop an education and awareness program to enhance public and professional appreciation of what oak

savanna is, its past prevalence, its rapid decline and current rarity, and its management needs. Because of the current rarity and long-time absence of oak savanna on the landscape, an

The recovery potential of oak savanna in Wisconsin is substantial.

- education program is greatly needed for developing support for its recovery and maintenance. The Department's Bureau of Parks and Recreation and the Bureau of Information and Education should play a major role in this effort.
2. Develop a policy on prescribed burning that recognizes the dependence of some ecosystems, including oak savanna, on fire and examines the resources and staff support necessary to effectively and safely use fire to manage these fire-dependent communities. In addition, air quality standards and policies within the Division of Environmental Quality will need to be clarified.
3. Pursue, as a high priority, protection and maintenance of all high-quality remnants (i.e., with high savanna species richness and community integrity) and mildly degraded sites with high recovery potential. Small, high-quality sites

should not be ignored, for they are probably the last refuge for many of the savanna plants, insects, and soil microflora and microfauna. Sites as small as a few acres may be contributing substantially to the genetic variation and survival of many species. This is a critical prerequisite to the success of Action 5, below.

Fire is an essential component of savanna ecosystems. To simulate wild fire, managers use prescribed burning as an important tool in restoration of oak openings and other fire-dependent communities. *Photo from Department State Natural Area Files.*

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4. Provide buffer lands to these small, high-quality sites. Buffer lands are needed if remnant oak savannas are to hang on to the species they have retained through 150 years of continual decline. Buffer lands provide remnants with protection against the negative impacts of external influences and stochastic events and provide space into which the community can expand and rebuild. Buffer lands should be restored with communities that are compatible with the remnants.
5. Pursue recovery and restoration efforts on as large, varied, and intact tracts as are available. There should be several sites 1,000-5,000 acres or more in size. Habitat fragmentation issues should be considered in selecting candidate sites. Large tracts are needed because of the dynamic nature of oak savanna vegetation, due to the shifting mosaic of sun and shade over time. The larger and more varied the restoration area, the greater the likelihood that the savanna community and its associated species will be able to maintain themselves in the long run.
6. Just what total recovery/restoration acreage goal in the state would ensure the long-term survival of the oak savanna community is unknown. Two to three percent (110,000-165,000 acres) of the original acreage may be a reasonable target. This goal, of course, would include both public and private lands. Whatever the final acreage goal, it should include representation of a variety of soil and topographic types as well as geographic locations. Based on the historical range of the community, distribution of the acreage goal within Department Districts should be approximately as follows:

Many opportunities exist for recovery on land already managed by the Department, especially within state parks and wildlife areas.

Southern District	45%
Western District	32%
Southeast District	14%
Lake Michigan District	7%
North Central District	2%

To reach these recovery/restoration acreage goals, some acquisition and protection of private land will be needed, but only for a limited number of high-quality sites. Much can be done for oak savanna in Wisconsin without new land acquisition. Many opportunities exist for recovery on land already managed by the Department, especially within state parks and wildlife areas. For example, the Kettle Moraine State Forest-Southern Unit region is an area with recovery potential on a large scale, and the Department's Southern District Headquarters grounds are a small but highly visible site with exceptional educational potential. There are also opportunities to encourage management for savanna, or at least components of it, on private lands through tax incentives, educational programs, and the offering of technical advice, assistance, and partnerships. The Habitat Restoration Areas component of the Wisconsin Stewardship Program may also provide some opportunities for regaining oak savanna.

7. Conduct research on oak savanna and related oak woodland ecosystems regarding plant community association and classification, effects of management on maintenance and recovery, and status of rare species and remnants.
8. Become an active partner in the Midwest Savanna Ecosystem Recovery Plan to be proposed by the U.S. Environmental Protection Agency. The plan will include recommendations on research, inventory, management, and protection of Midwest savannas. This plan was first

discussed at the Midwest Oak Savanna Conference held in Chicago (February 18-20, 1993), organized by the Illinois Chapter of The Nature Conservancy, the U.S. Environmental Protection Agency Region 5, and the College of Natural Resources, UW-Stevens Point.

9. Encourage the establishment of sufficient sources of seeds and plant material using local genotypes of oak savanna species.

Case Study

KETTLE MORaine OAK OPENING: NATURAL COMMUNITY PROTECTION AND RESTORATION THROUGH MASTER PLANNING

Contributed by Mark Martin, Randy Hoffman, and Signe Holtz.

The Natural Resources Board approved the master plan for the Kettle Moraine State Forest in 1991 after a long planning process that included a Department task force, a vegetation management committee, a citizen's advisory committee, various resource management specialists, citizens, and other organized groups. The state forest, as its name indicates, lies in the kettle moraine area of southeastern Wisconsin. Along the moraines in the Southern Unit are oak openings and oak woodland, and in the kettles and lowlands lie vast wetlands of prairie, fen, and sedge meadow. Dry prairies cover the southern- and western-facing hillsides. The Southern Unit also contains many populations of rare species (listed as endangered or threatened or of special concern), including 11 bird species, 18 plant species, seven insect species, and two mammal species.

As the planning process progressed, it became apparent that this property could contribute greatly to the protection of Wisconsin's natural heritage because it harbored degraded oak openings, one of the rarest natural communities in the state. As the largest block of public land in the southeast with more than 29,000 acres in the project boundary, it would also be one of the only opportunities in southeastern Wisconsin to restore an oak opening at the scale that it had occurred in the past. There were several sites with great restoration potential because of the existing tree structure and because surrounding public land ownership gave the Department the ability to manage effectively using prescribed burning. Out of this discussion came the proposal to create the Kettle Moraine Oak Opening, which would include the existing Blue Springs Oak Opening and three parts of the Messinger Dry Prairie and Savanna Preserve.

The proposal became part of the master plan and since then the Department has been preparing the site for larger prescribed burns. First, crews have been removing buckthorn and honeysuckle, both non-native species, by cutting and using spot-herbicides. Second, they have burned small prairie patches to stimulate existing prairie plants to produce more seeds. This seed production, combined with the removal of the non-native shrub layer, should allow prairie to expand more easily across the site.

Soon, the Department will burn much larger parts of the oak opening: 100-700 acres at a time, and at fairly short intervals (two or three years). As Randy Hoffman of the Department's Bureau of Endangered Resources explains, "This is a 100-year work-in-progress." As time goes by, the Department will examine the results, monitor restoration research, and change management as needed.



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